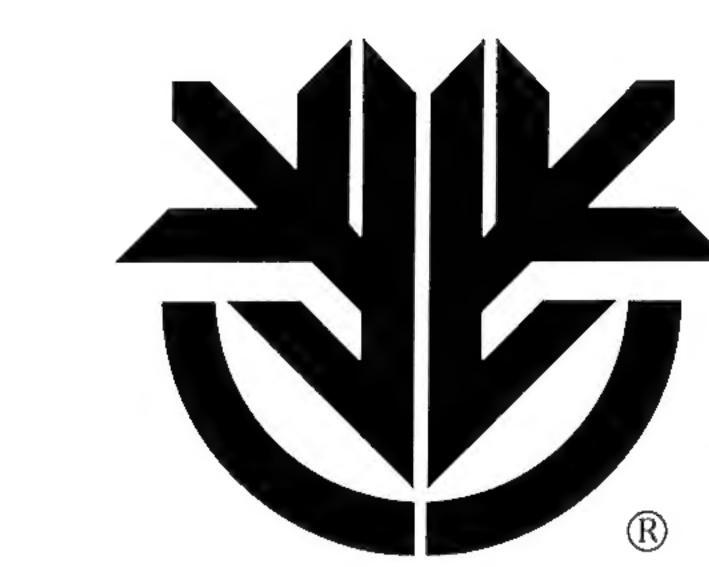




The Solanaceae Family





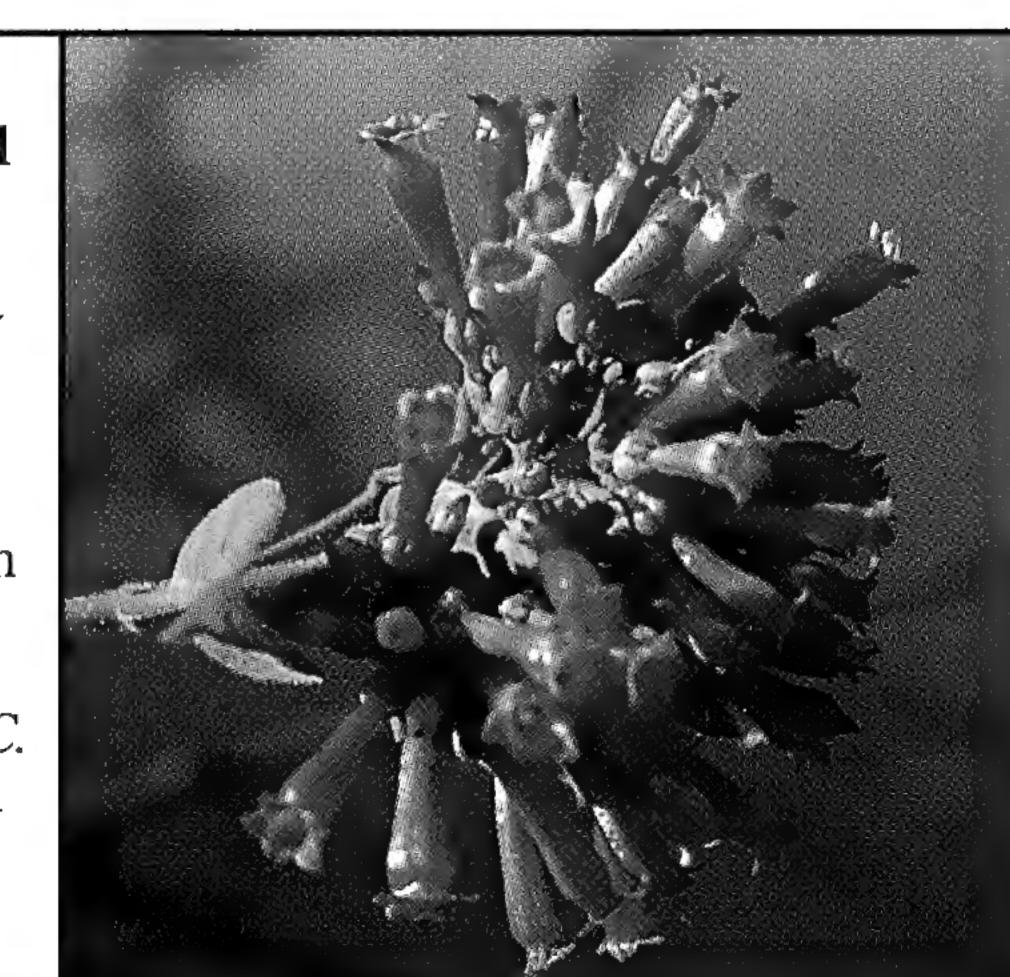
Leaves and Flowers: Leaves are alternate along the stems and may be toothed or lobed, sometimes both on the same plant. Typical flowers have 4 or 5 petals with both calyx and corolla united below. The ovary and stamens arise from the corolla, which surrounds a single style as seen in Capsicum annuum, right. An enlarged fruiting calyx is common in the family. Internal structures of stems, chemistry, and other inconspicuous details differentiate Solanaceae from other families. [WGD]



Two Subfamilies — Solanoideae and Cestroideae: Solanoideae has about 80 genera, including Solanum, one of the world's largest genera of flowering plants with more than 1,000 species. Solanum anthers have terminal pores which shed pollen from the narrow apex. The corolla often opens like a dish beneath the stamens, as in Solanum myoxotrichum, right. Many species of the Solanoideae have calyces that enlarge around the fruits, which typically contain many seeds. [WGD]



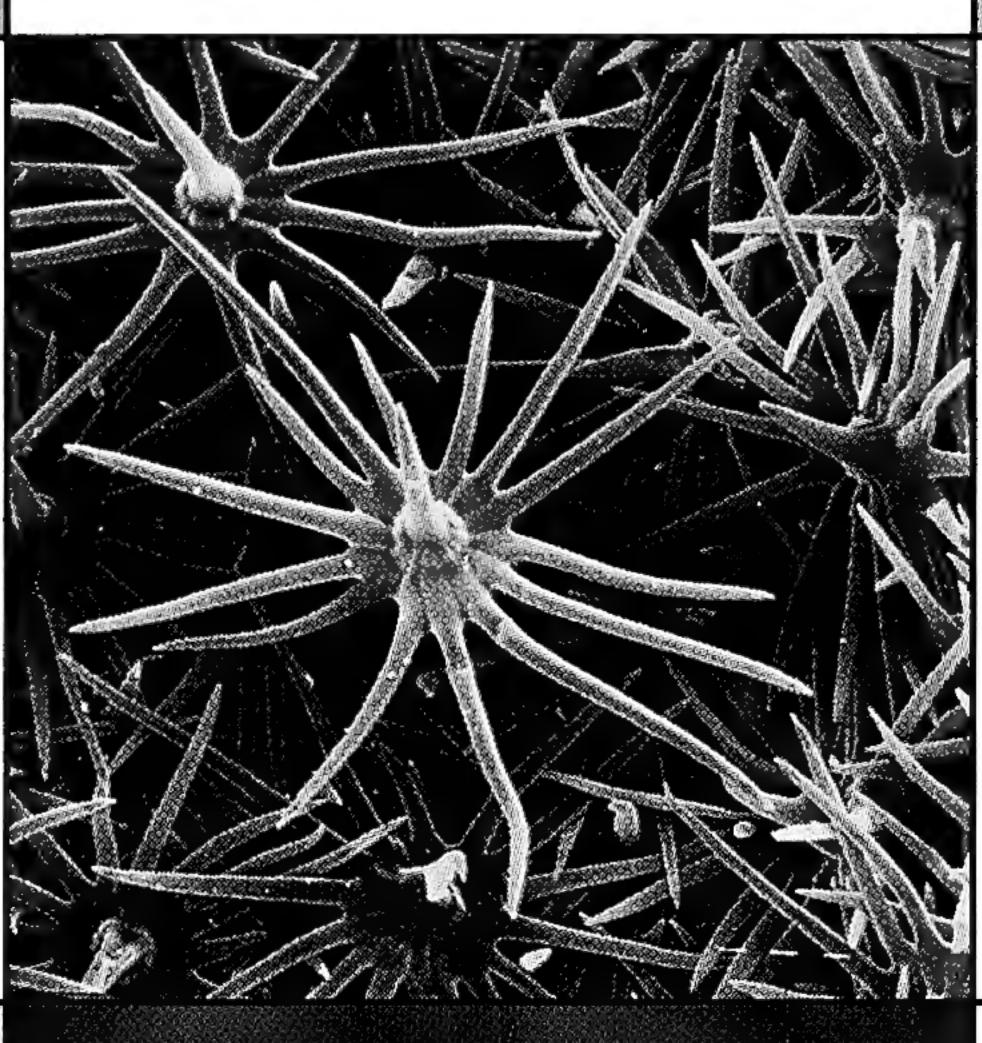
Subfamily — Cestroideae: Confined to the Americas, Cestroideae has about 18 genera. Most have narrow flowers, thick seeds, and a wide variety of chromosome numbers. Cestrum, a large genus in this subfamily, is being intensively studied by William G. D'Arcy, a senior curator at MBG and an expert in the Solanaceae. Most Cestrum species have inconspicuous flowers that open at night, but C roseum, right, and a few other Mexican species have bright flowers that attract hummingbirds in the daytime. [WGD]



The Solanaceae or Potato family includes some of the world's most economically valuable plants, such as potatoes, tomatoes, peppers, tobacco, and petunias. This widespread family has over 2300 species in nearly 100 genera, concentrated in South and Central America and represented in Africa, Australia, Europe, Asia, and North America. Richest in the tropics, the family also has many temperate members. It includes herbs, shrubs, vines, and a few trees. Much of the family is still poorly known to science. [CW]



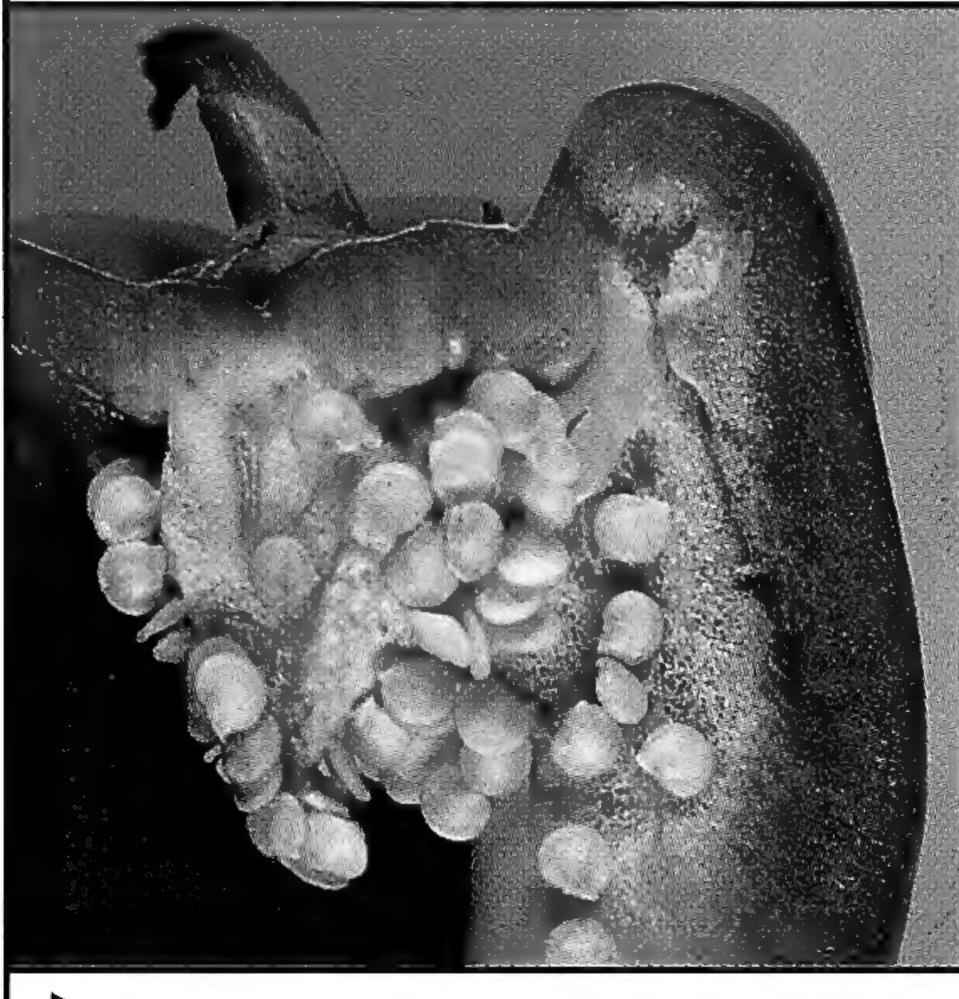
Stellate Hairs: The Leptostemonum group of Solanum form prickles and stellate hairs, which provide protection from insects and grazing animals. The hairs may also shield the plants from intense sunlight in semidesert and savanna habitats. The intricate hairs from a silverleaf nightshade, Solanum elaeagnifolium, are shown in a scanning electron micrograph, right. At left, Solanum mahoriensis, a recently described species from Madagascar, displays prickles on stems, leaves, and calyx. [WGD], [SE]



Classification — New: The genus Lycianthes, with over 100 species in the Neotropics and Asia, has many similarities to *Solanum*, such as anthers with apical pores. However, D'Arcy of MBG has demonstrated that vein patterns in Lycianthes calyces are very different from those in Solanum. Recent molecular studies show that the two genera have different evolutionary histories and are not so closely related as once thought. New scientific techniques are leading to many changes in plant classification. [WGD]



Anthers — Calcium deposits: Most species of Solanaceae have a special area in the anthers where calcium deposits accumulate. Below, anthers of Vassobia breviflora, a tree from warm temperate South America, show a white line of calcium, which will be transferred to pollinating insects. The purpose of this calcium dispersal system is unknown, but Solanaceae tend to bloom more when grown in limestone soils.



Solanoideae — Seeds and Embryos: The subfamily Solanoideae has regular, open flowers, uniform chromosome numbers, and berry fruits. Seeds are mostly round and flat, as seen in tomatoes or in peppers, shown at left. The embryo curls just inside the edge of the seed; in some species it coils around more than twice. In the magnified view of an embryo of Saracha punctata, right, the division at the top separates the cotyledons, the first leaves to appear after germination. [WGD], [WGD]

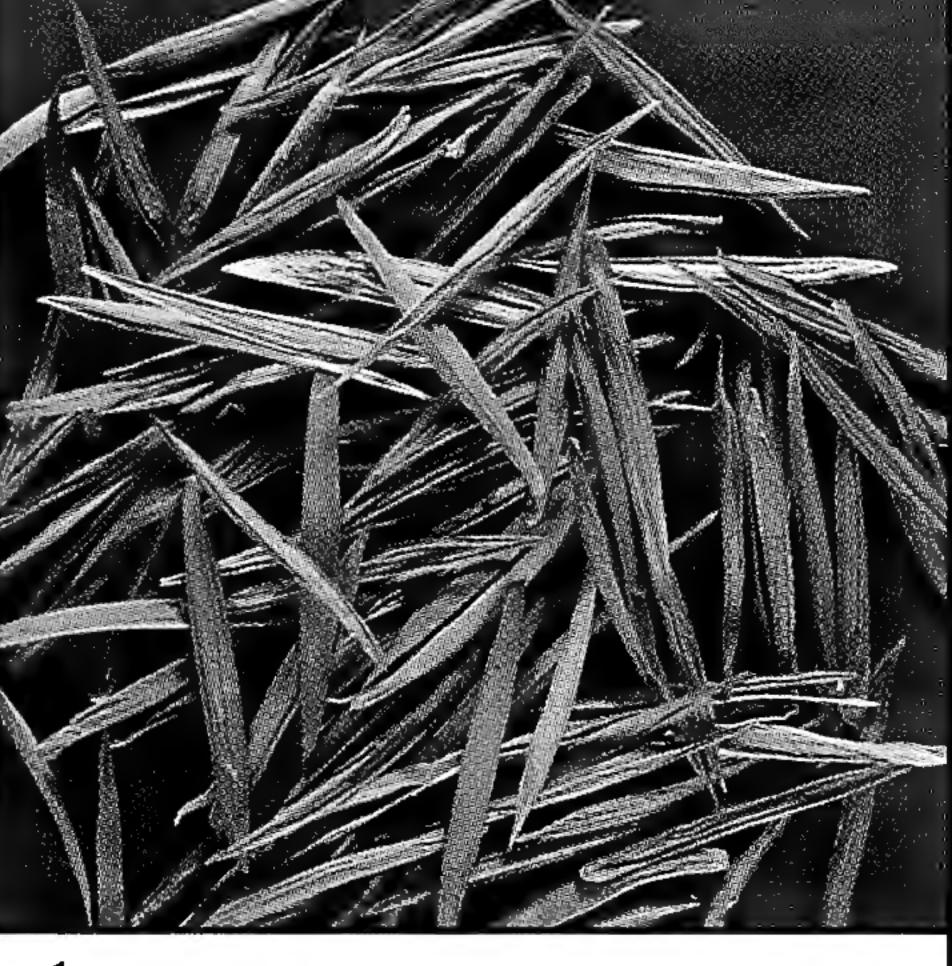


Pollination — Insects: Solanum and Lycianthes are "buzz pollinated." As bees grasp the anthers, the buzzing of their wings causes the anthers to vibrate, expelling pollen from minute pores at the tips. The dry pollen puffs out, coating the insect. Solanaceae species are pollinated by many kinds of insects, including moths, bees, and flies, and also by birds and bats. Many species flower only at night when their pollinators are active. [JC], [WGD]

Deforestation destroys habitats of the pollinators on which isolated plant populations depend, leading to wider loss of species. Global biodiversity is concentrated in the tropics, home to 170,000 of the world's 250,000 species of flowering plants and the majority of Solanaceae. Pressures on natural ecosystems from growing human populations, economic development, agriculture, logging, and other deforestation are serious in most countries. Scientists estimate that most tropical forests will be damaged or destroyed in the next 20 years.



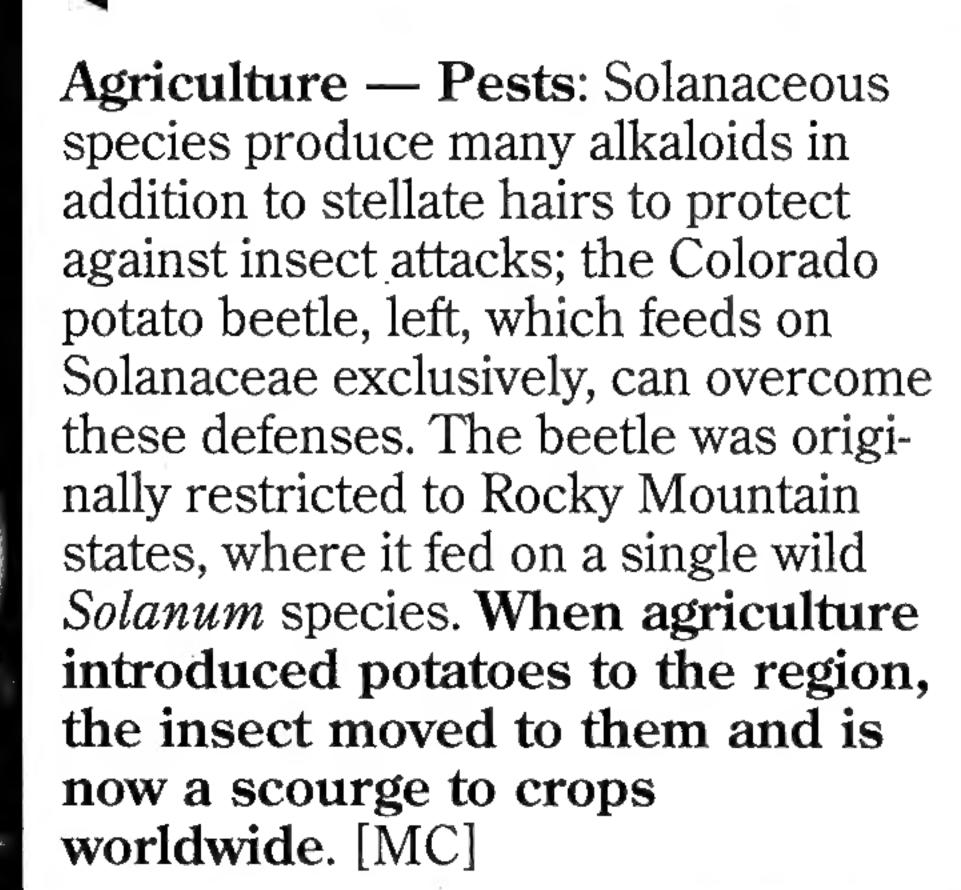
Systematics — Taxonomy: Metternichia, the only member of the Solanaceae with winged seeds, is known only from eastern Brazil. Until recently it was grouped with the Cestroideae, but it may relate to genera in Cuba and Hispaniola instead. Correct taxonomic classification of plants provides the basic information needed to utilize, manage, and conserve species for the future. MBG is a world leader in systematics, or taxonomy, the science of classifying plants and their evolutionary relationships. [WGD]



Foods — Potatoes: Originally from uplands of Peru or Chile, Solanum tuberosum is now cultivated in temperate regions worldwide. It **feeds** more people than any other dicotyledonous crop. The potato, a perennial plant, is grown as an annual to help avoid damage from frost and pests. Crossbreeding with wild species strengthens potato crops, and the preservation of diverse genetic resources is essential for future yields of world agriculture. [WGD]



Biogeography — Eggplant: Solanum melongena belongs to the spiny Leptostemonum Solanum group. The species was first domesticated in Southeast Asia, but its ancestor may have floated there from Africa, where many similar species are found.

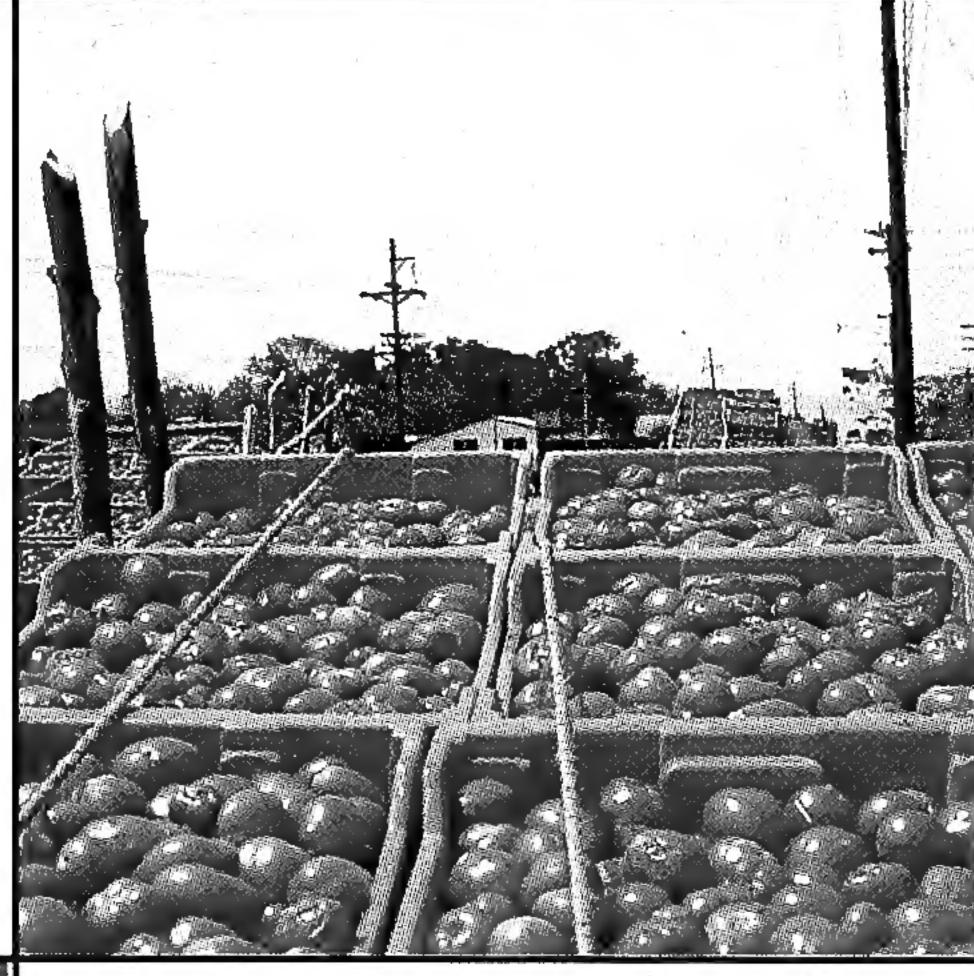




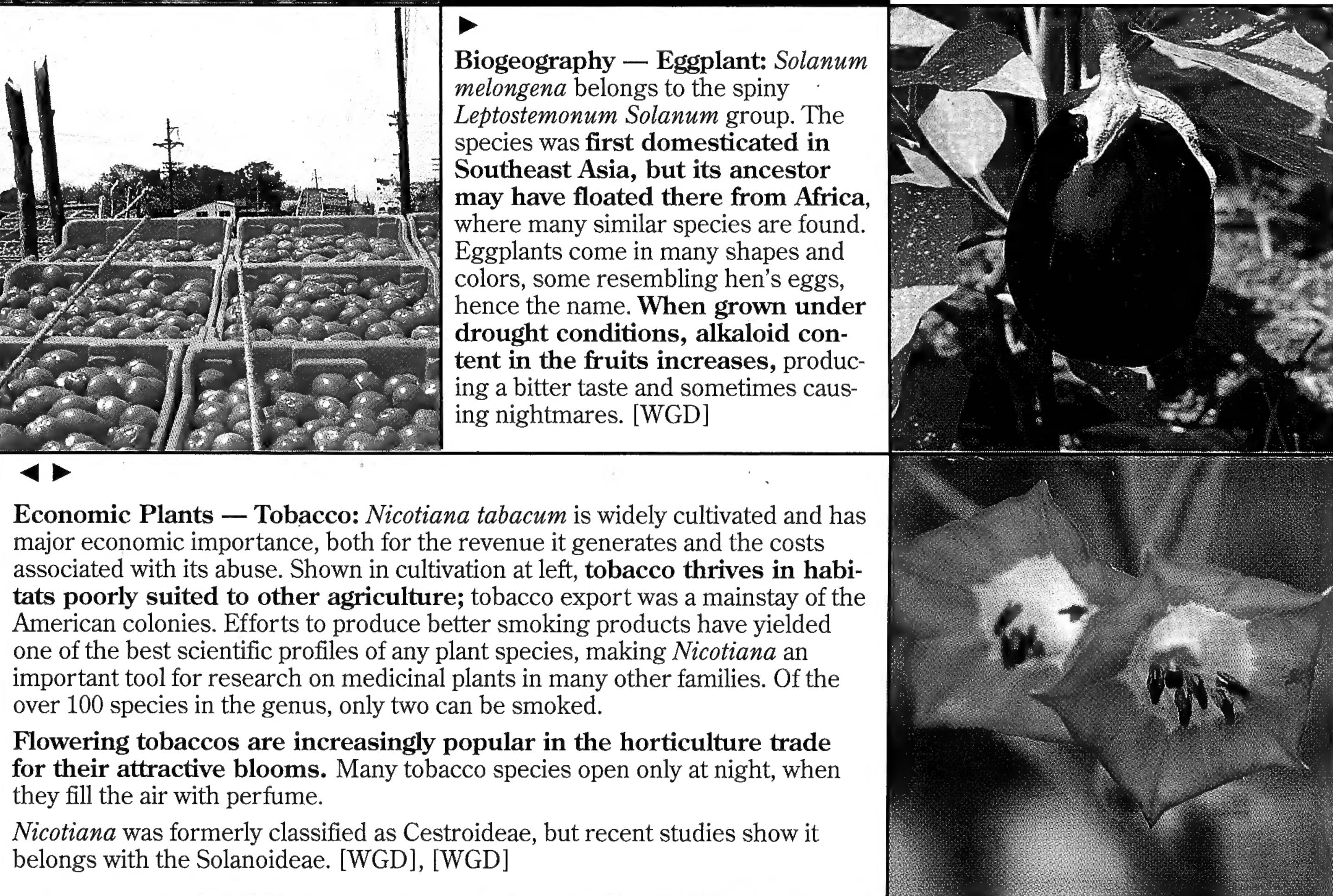
Ornamentals — Petunias: Petunia hybrida is a major commercial crop in the garden trade. Derived from species of eastern South America, petunias have been extensively hybridized to produce a wide variety of shapes and colors for gardens and landscaping. Many temperate Solanaceae are grown for their attractive flowers. Although most species are tropical, many do not withstand constant heat, and few tolerate frost. Many species, such as Solandra, or Cup of Gold, are flowering favorites in the tropics. [JJ]



Foods — Peppers and Tomatoes: Now cultivated worldwide, these crop plants were domesticated in Mexico from wild species whose ancestors migrated from South America. At left, peppers, Capsicum annuum, come in many colors and shapes. Tomatoes, right, long known as Lycopersicon esculentum, are known today as Solanum esculentum, after research showed that tomatoes and potatoes are on the same evolutionary line. Tomatoes' red color comes from the pigment lycopene, chemically similar to carotene. [WGD],



Eggplants come in many shapes and colors, some resembling hen's eggs, hence the name. When grown under drought conditions, alkaloid content in the fruits increases, producing a bitter taste and sometimes causing nightmares. [WGD]



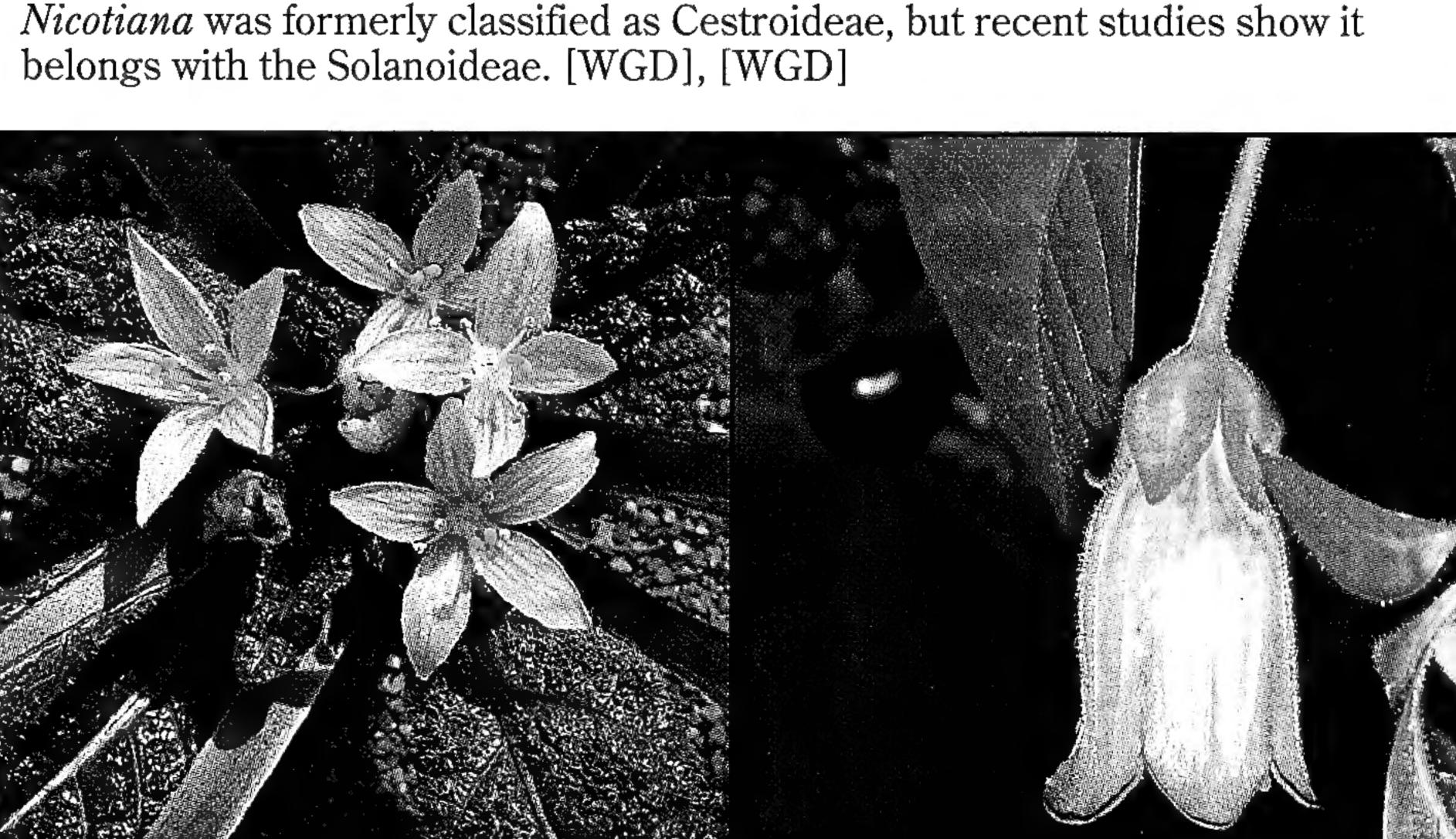
Ornamentals — Tropical: Many Solanaceae have showy, attractive flowers. Brugmansia, sometimes called angel trumpet or floripondio, is popular in tropical gardens, and its quick-rooting stems are sometimes used as living fenceposts. Overcollected for its showy flowers and alkaloid content, truly wild populations are no longer known in spite of Brugmansia's ability to persist in disturbed locations. The genus, with about five species, was once richest in Ecuador. [WGD]



Ornamentals — Temperate: At left, painted tongue, Salpiglossis sinuata, native to the cooler regions of South America, prefers cool summers and is grown mostly in northern regions of America and Europe. Another species, Solanum dulcamara, the bittersweet of Europe, is naturalized in the northeastern United States. Other Solanaceae ornamentals grown in North America are butterfly flowers or Schizanthus, nierembergias, shoo-fly plants or Nicandra, and browallias. [WGD]



Pharmaceuticals — Ethnobotany: Mandrake, Mandragora officinalis, has a long tradition in folklore as a remedy and an hallucinogen, and magical properties are attributed to its fruits. Its thick yellow roots contain the tropane alkaloid scopolamine, or hyoscine. Medieval witchcraft ascribed aphrodisacal properties to the roots, in part because they seemed to resemble men's bod-



major economic importance, both for the revenue it generates and the costs

American colonies. Efforts to produce better smoking products have yielded

important tool for research on medicinal plants in many other families. Of the

Flowering tobaccos are increasingly popular in the horticulture trade

for their attractive blooms. Many tobacco species open only at night, when

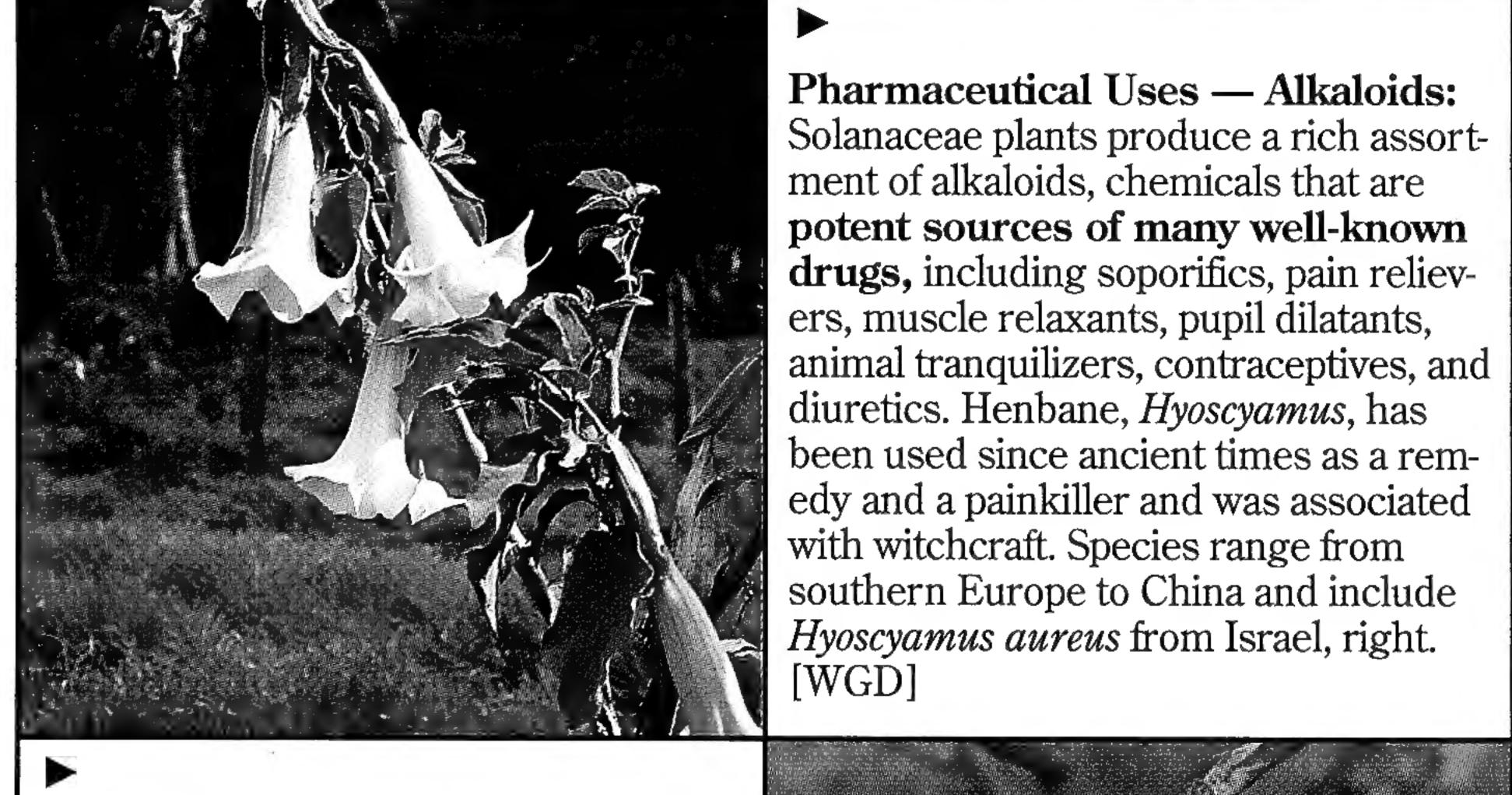
one of the best scientific profiles of any plant species, making Nicotiana an

over 100 species in the genus, only two can be smoked.

they fill the air with perfume.

Pharmaceuticals — Atropine: Atropa belladonna, the deadly nightshade of Europe, and its relatives contain tropane alkaloids, notably atropine, an important drug compound. The potent alkaloids in tomato leaves are toxic, and green potatoes have caused deaths in humans. MBG researchers collect plant specimens in Africa, Madagascar, and Suriname for screening by the National Cancer Institute and others searching for potential pharma-

cuetical compounds. [WGD]



its unusual berries, which yield a natur-

al insecticide. The natural agents of dis-

persal for such large fleshy toxic fruits

Only 10% of the world's 250,000

species of flowering plants have

uses. TROPICOS, the botanical

world's largest and most widely

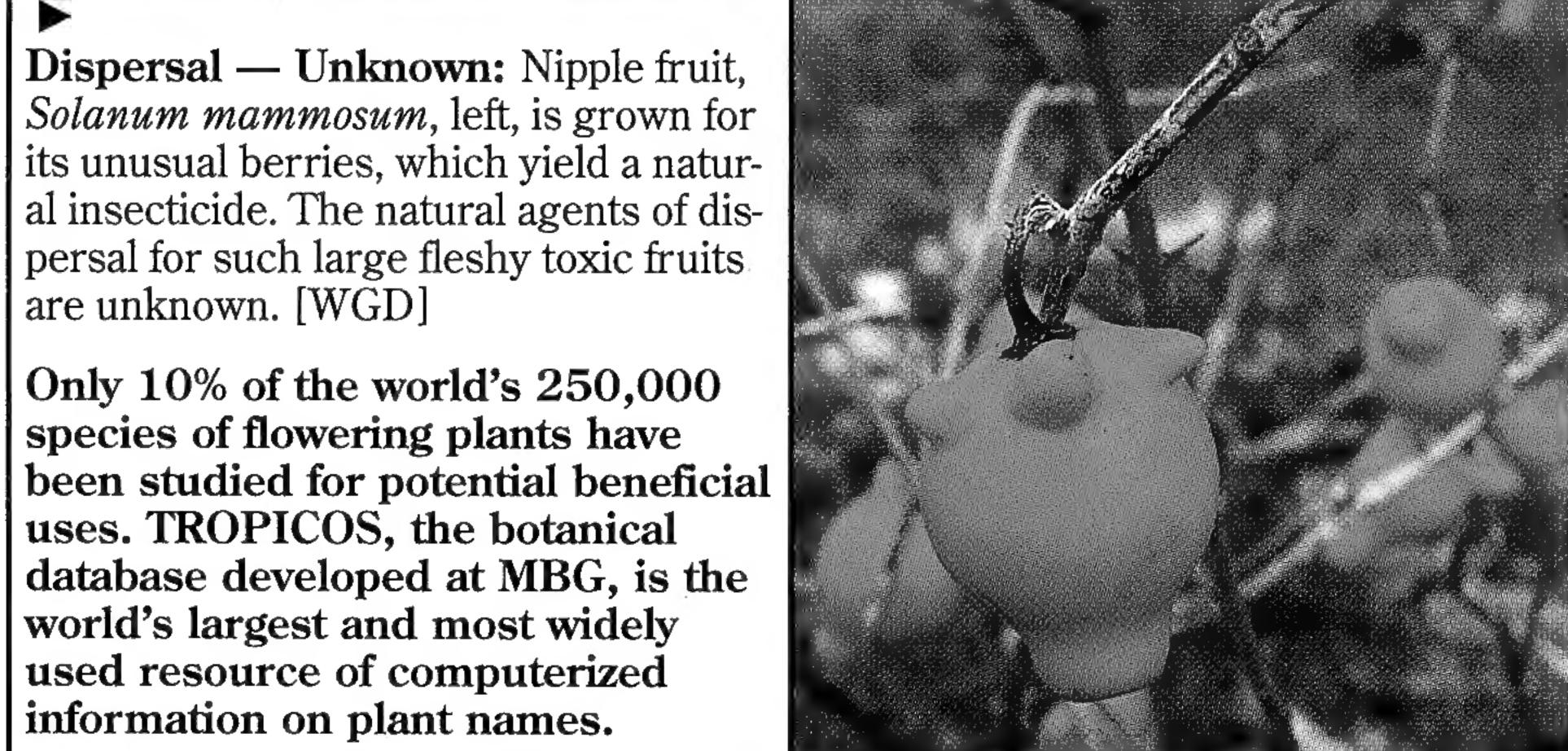
used resource of computerized

information on plant names.

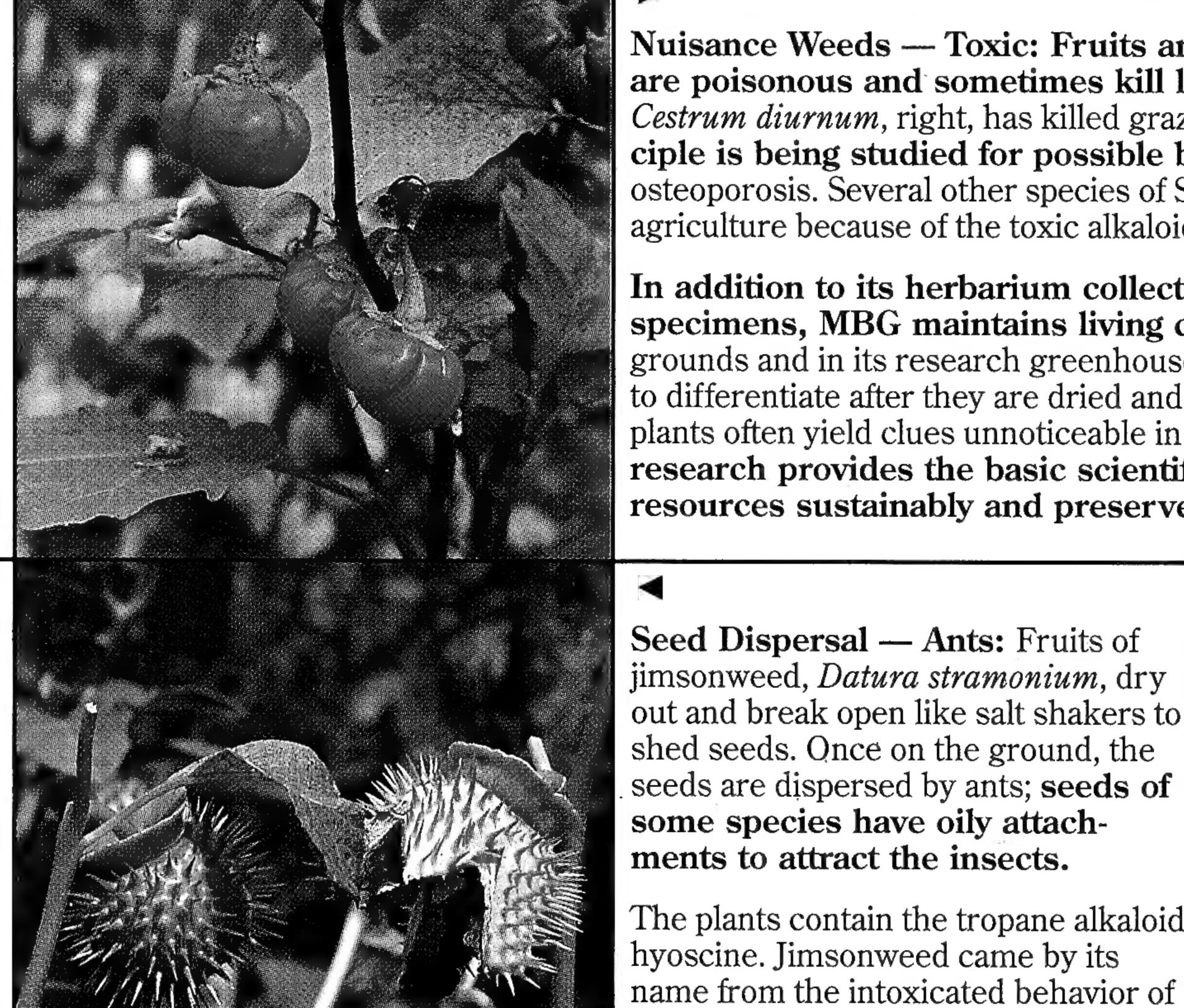
database developed at MBG, is the

are unknown. [WGD]

ers, muscle relaxants, pupil dilatants, animal tranquilizers, contraceptives, and diuretics. Henbane, *Hyoscyamus*, has been used since ancient times as a remedy and a painkiller and was associated with witchcraft. Species range from southern Europe to China and include Hyoscyamus aureus from Israel, right. **Dispersal** — **Unknown:** Nipple fruit, Solanum mammosum, left, is grown for



Fruits — Solanum: In Africa there are more than 100 species of Solanum; many are eggplant relatives that are eaten by indigenous peoples. Not only the fruits, but the leaves of some species are cooked and eaten. One of these is Solanum aethiopicum, right, which is also cultivated in North America for use in decorative plant arrangements. [WGD] MBG is the North American center for African botany and maintains active exploration and training programs in several African countries.

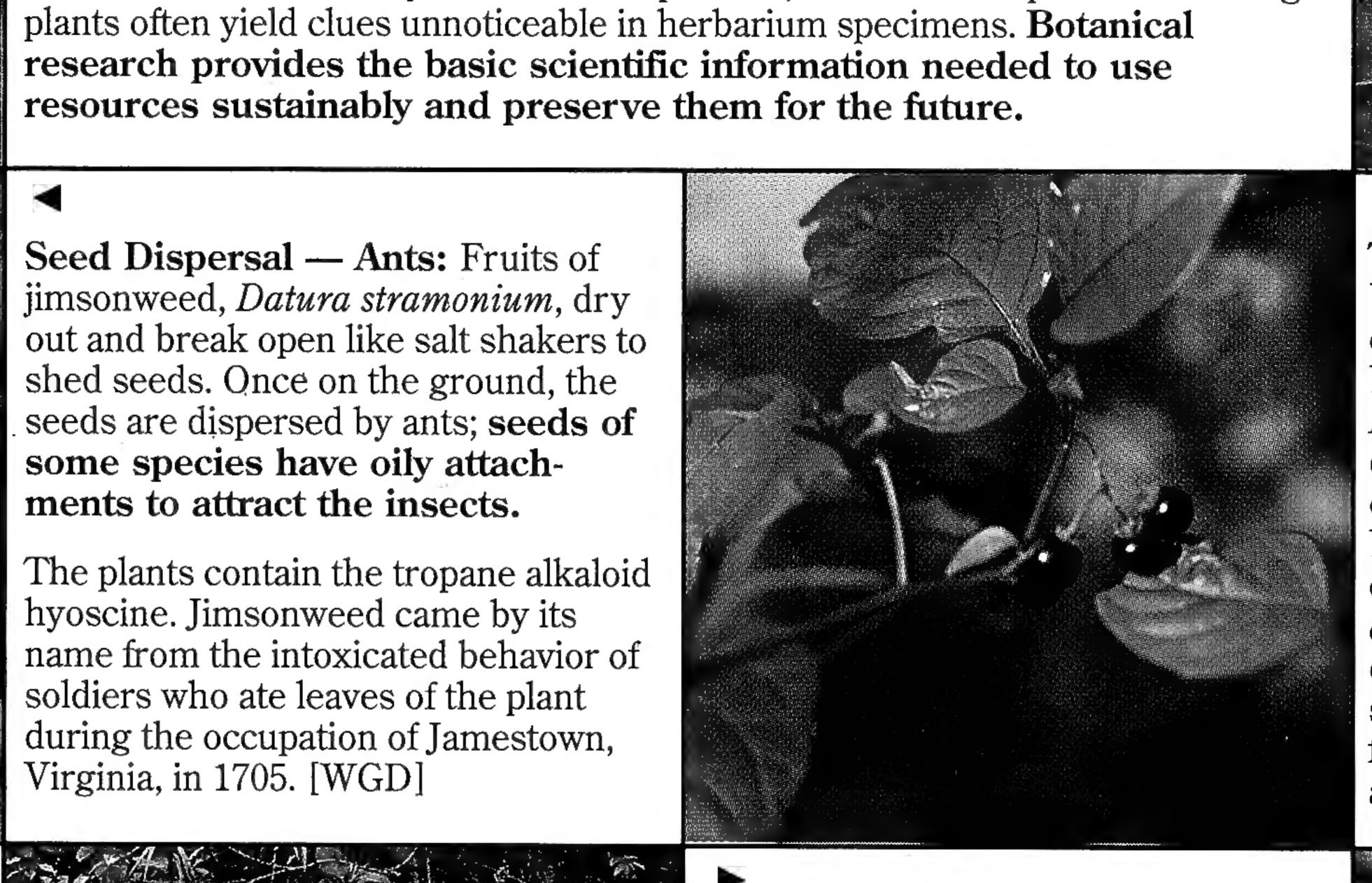


ies. Mandrake does not occur in the

wild in North America. [WGD]

Nuisance Weeds — Toxic: Fruits and leaves of many Solanaceae species are poisonous and sometimes kill livestock that accidentally feed on them. Cestrum diurnum, right, has killed grazing horses in Florida, and its toxic principle is being studied for possible beneficial effects on human aging and osteoporosis. Several other species of Solanaceae are considered a nuisance to agriculture because of the toxic alkaloids in their foliage. [WGD]

In addition to its herbarium collection of more than 4.7 million dried specimens, MBG maintains living collections of plants for study on its grounds and in its research greenhouses. Many Solanaceae genera are difficult to differentiate after they are dried and pressed, but close comparisons of living plants often yield clues unnoticeable in herbarium specimens. Botanical research provides the basic scientific information needed to use resources sustainably and preserve them for the future.



Toxic or Edible: About 30 species of black nightshades, the Solanum nigrum complex, are native to South America, but a few occur in Europe, Africa, and Asia. Some are poisonous, but the wonderberry, Solanum scabrum, is cultivated in Africa and Madagascar for its edible fruits. Leaves and stems of the tropical black nightshade at left, Solanum americanum, are boiled and eaten. It is distinguished from poisonous species by tiny anthers, shiny fruits, and calyx lobes that reflex away from the fruits. [WGD]

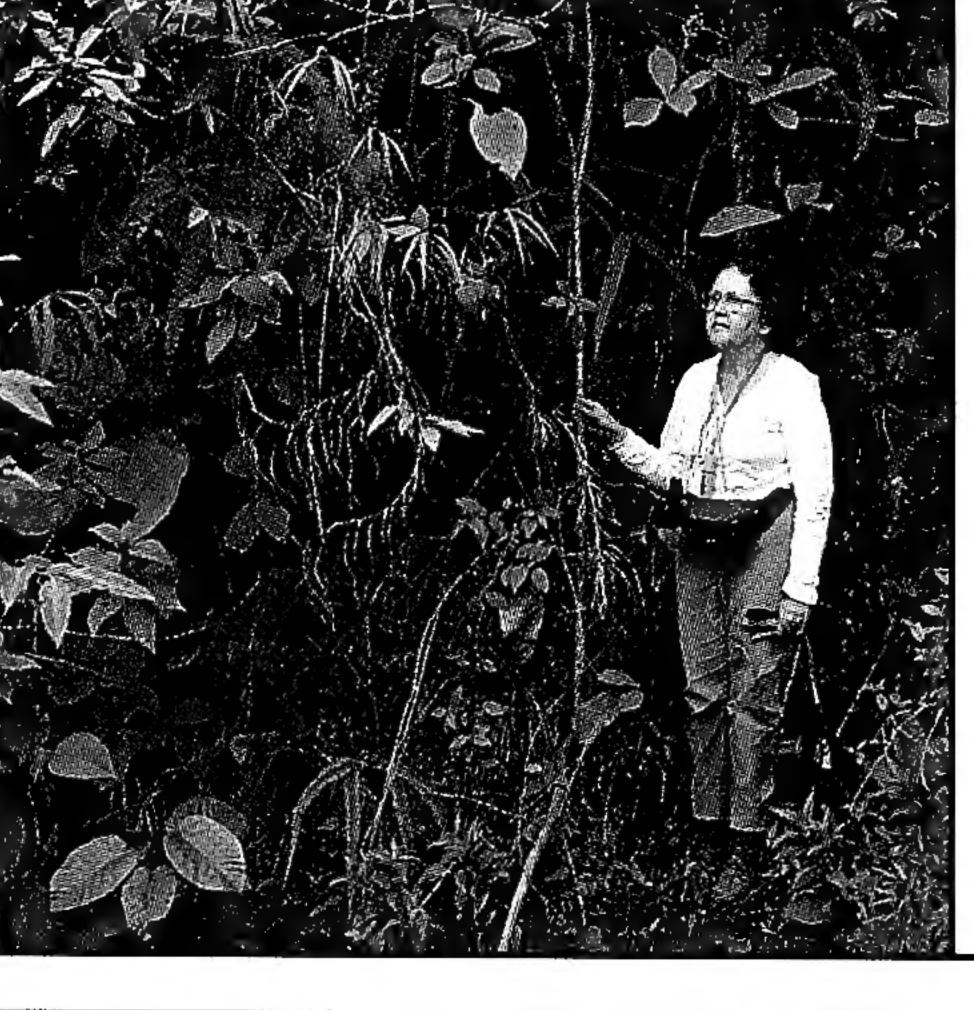


Discovery — New species: MBG staff discover and describe about 200 new species every year. Rahowardiana wardiana, left, is a shrub found high in the canopy of Panamanian rain forests. Another species, R. globifera from Colombia, was described in 1993 by MBG researchers. [JL] Plants closely associated with host trees are especially vulnerable when mature forests are cleared. ▼ Below, Solanum toliaraea from Madagascar is known only from coastal sites north of the city of Tulear, for which the species was named. [WGD] Below right, Solanum marojejy, also from Madagascar, was discovered by MBG researcher James Miller. [GS] Many new species are discovered during preparation of floras, the cata-

logs of all plants in a given area. MBG is headquarters for more than 20 major floristic projects worldwide. Floras require field work to locate plants, analysis of specimens, and checking results with existing data. Flora preparation is the starting point for most scientific studies of plant groups.



International Collaboration: Carmen Benítez de Rojas, one of MBG's many collaborators in other countries, is a Venezuelan specialist on the Solanaceae. She is shown with a rare Cestrum bigibbosum in western Venezuela during field work in a study with MBG, which was supported by the U.S. National Science Foundation and its Venezuelan counterpart. Results will be published in the *Annals* of the Missouri Botanical Garden, a major scientific journal of international botanical research. [WGD]



Seed Dispersal — Ants: Fruits of

seeds are dispersed by ants; seeds of

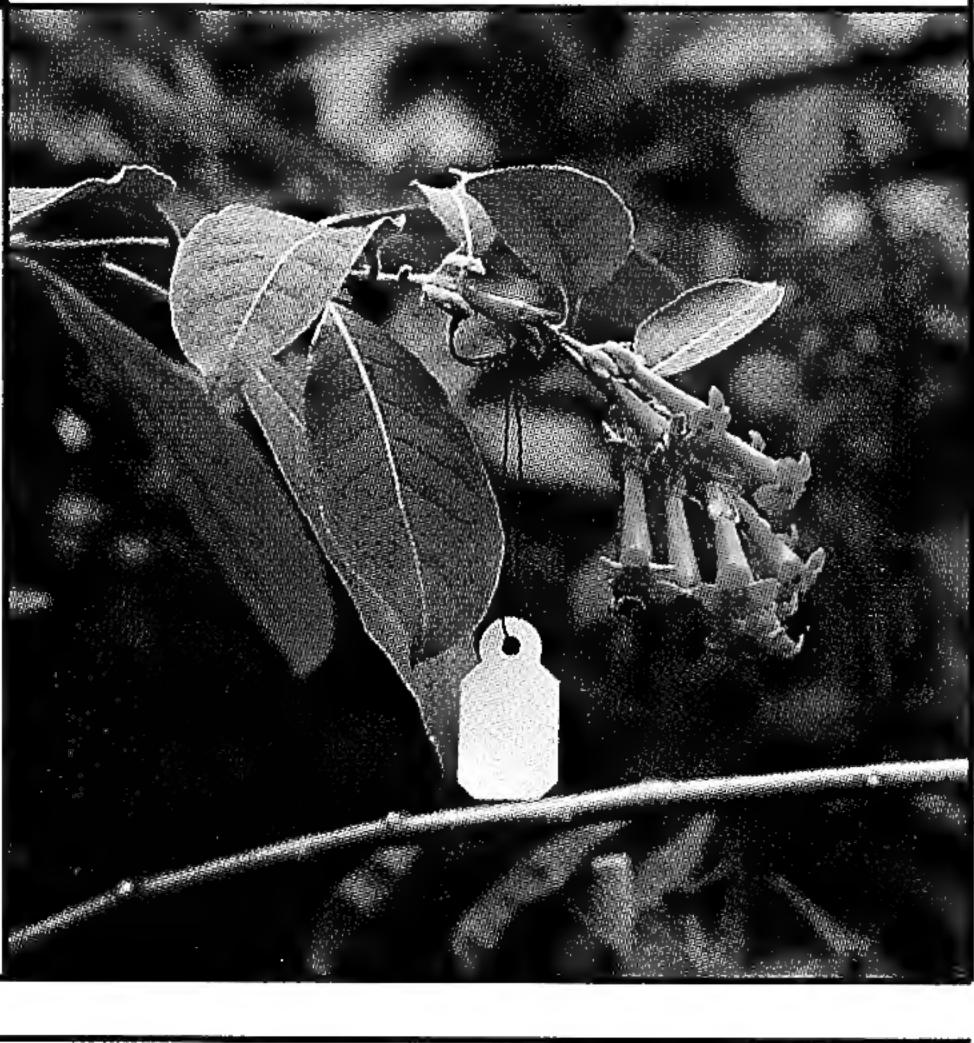
some species have oily attach-

soldiers who ate leaves of the plant

Virginia, in 1705. [WGD]

during the occupation of Jamestown,

Research — Cultivation: Many Solanaceae species can only be adequately studied in the greenhouse, where daily and seasonal comparisons can be made. Researchers monitor plants' development, nectar quality, chromosome behaviour, and nutritional responses. At right, Cestrum psittacinum, which has lovely flowers, has not been seen for more than a century in its native Mexico; the species is maintained in botanical greenhouses. [WGD]



Dedication

Three scientists on the cutting edge of Solanaceae investigation are emerging as leaders in the field. Each collaborates with William G. D'Arcy at MBG: Lynn Bohs, Duke University: Systematic studies of South American Solanum, using traditional and molecular methods. Richard Olmstead, University of

Washington: How the Solanaceae relates to other families using molecular (DNA) methods. David Spooner, United States

Department of Agriculture and University of Wisconsin: Systematics of potatoes and tomatoes using field studies, cultivation and molecular methods.

Research at the Missouri Botanical Garden About fifty Ph.D.-level scientists, many of whom live abroad, technical staff, and graduate students are devoted to studying plants. These efforts are concentrated in Mesoamerica, South America, subsaharan Africa, Madagascar, China, and North America. Individual MBG scientists are specialists in the plants of particular regions or in the classification of major plant families. MBG serves as headquarters for the Center for Plant Conservation and for the major collaborative projects Flora of China, Flora Mesoamerica, and Flora of North

America. To help disseminate botanical information, MBG floristic research and library resources are available on the Internet at <http://www.mobot.org>. MBG botanists collaborate with local institutions in each country where they conduct research, providing technical expertise, assisting with fundraising, establishing better communication with the worldwide scientific community, training botanists in the field and at MBG, and helping to build infrastructure. Botanical research provides basic scientific knowledge needed to develop conservation policies to preserve global biodiversity.

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University [WGD] William G. D'Arcy, MBG

Suzanne Eder, Southern Illinois University Jack Jennings, MBG

James Luteyn, New York Botanical Garden Monsanto Corporation [GS] George Schatz, MBG

Cliff Willis, MBG

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[CW]